

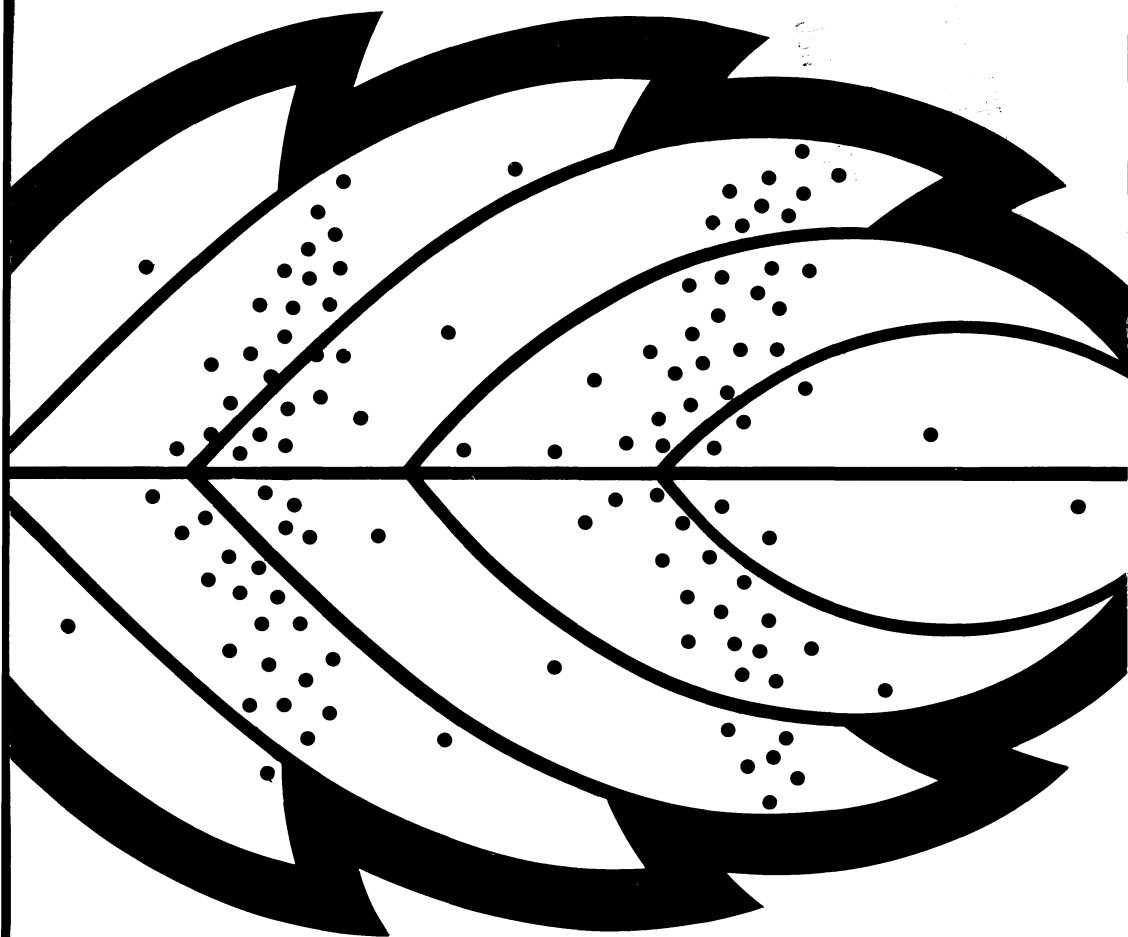
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Aphids on Leafy Vegetables



UNITED STATES
DEPARTMENT OF
AGRICULTURE

FARMERS' BULLETIN
NUMBER 2148

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This publication is intended for the commercial grower of those vegetables whose leafy or flowering parts are marketed. For recommendations on the control of aphids on such crops in the home garden, see Agriculture Information Bulletin 380, "Insects and Diseases of Vegetables in the Home Garden."



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APHIDS

ON LEAFY VEGETABLES

How To Control Them

By W. J. REID, JR.,¹ and F. P. CUTHBERT, JR.,² ARS entomologists

Aphids, often called plant lice, are small, soft-bodied insects that suck juice from plants. They are present wherever crops are grown.

Aphids cause heavy losses to growers of leafy vegetables by—

- Reducing vigor and yield of plants.
- Contaminating edible parts.
- Transmitting destructive virus disease of plants.
- Killing plants, if infestation is heavy.

Most species of aphids are about $\frac{1}{16}$ inch long. Species differ in color.

Some individuals of most species have wings; others do not.

Male aphids are rare. Females of all species give birth to living young in the summer. When cold weather approaches, females of

most species mate and lay eggs. Females live about a month, and produce 80 to 100 young.

KINDS OF APHIDS

Several species of aphids attack leafy vegetables.

Green Peach Aphid

The green peach aphid,³ known also as the spinach aphid and the tobacco aphid, is about the size of a cabbage seed. Both wingless and winged types are yellowish green or pinkish green; the winged type is darker.

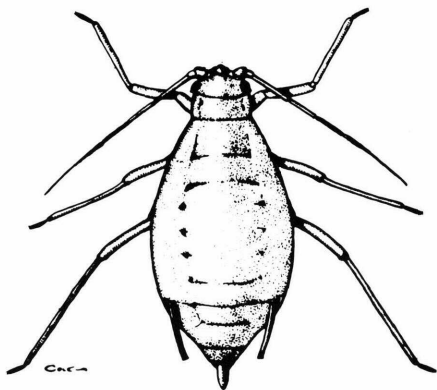
This aphid feeds on many plants. It is most destructive to spinach, beets, celery, lettuce, and chard. It also causes some injury to cabbage and related cole crops, dandelion, endive, mustard greens, parsley, and turnip.

It spreads several virus dis-

¹ Retired.

² Vegetable Insects Laboratory USDA, Charleston, S.C. 29407

³ *Myzus persicae*.



BN-10059

Green peach aphid, wingless form.

eases of plants, including beet mosaic, beet yellows (which also attacks spinach), and lettuce mosaic.

In the Southern States, in Arizona and California, and in extreme western Oregon and Washington, nearly all green peach aphids are females that deposit their young without mating. Reproduction takes place throughout the year. As many as 30 generations a year occur in the extreme South.

Continuous reproduction by unmated females, and overwintering of this form of the insect, occur as far north as warmer parts of New Jersey, Maryland, Virginia, Tennessee, Arkansas, and Oklahoma, and in at least one area in Washington.

In these and colder areas, males and egg-laying females also develop in the fall. This aphid generally survives the winter only in the egg stage in areas where minimum temperatures drop to 0° F. or below. Eggs are laid mostly on

peach, wild plum, and cherry trees. They hatch in the spring, and the young aphids feed where the eggs were laid. New broods develop and spread to vegetables and other host plants.

Cabbage Aphid

The cabbage aphid* is found throughout the United States. It is distinguished from other species by a powdery, waxy covering over its body. Color is grayish green.

This aphid feeds primarily on cabbage, cauliflower, collards, broccoli, kale, and other cole crops. It seldom damages mustard or turnips.

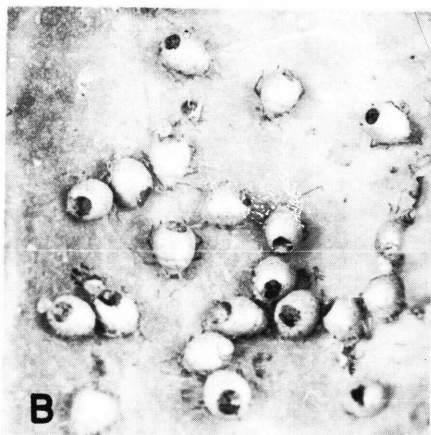
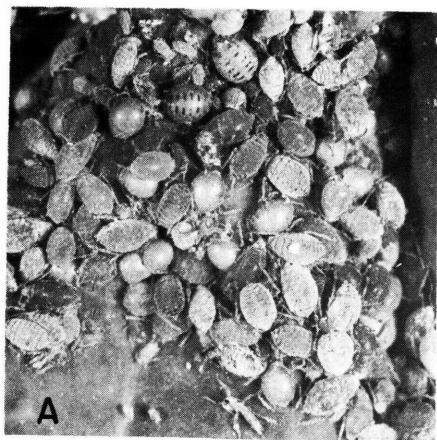
In the Southern States, 30 or more generations of females, both winged and wingless, are produced throughout the year. In colder climates, males and females occur in the fall; they mate and the females lay eggs that sur-

* *Brevicoryne brassicae*.



TC-7319

Cabbage plant injured by cabbage aphids.



TC-7322, TC-7323

Cabbage aphids: A, Several near center of picture have been killed by a parasitic insect, have lost their powdery covering, and have become shiny tan; B, Bodies of aphids after emergence of the parasites through the circular openings.

vive the winter. Eggs of this aphid usually are laid on the residues of host crops that have been left in the field.

Turnip Aphid

The turnip aphid ⁵ is also called the turnip louse and the false cabbage aphid.

This aphid resembles the cabbage aphid, but does not have a waxy body covering. It is pale green. The winged form has black spots, a black head, and transparent wings marked by black veins.

The turnip aphid is widely distributed in the United States and causes heavy losses to growers, especially in the South. It feeds chiefly on turnip, mustard, and radish plants. It also injures other crucifers, particularly in their seedling stage.

Full-grown females give birth to 50 to 100 young during their reproductive period of 20 to 30 days. In the Gulf Coast region as many as 46 generations have been observed in a year.

The habits of this insect are similar to those of the cabbage aphid, except that egg laying is rare.

Other Aphids

The bean aphid ⁶ ranges in color from dark olive-green to black. It has been found on beets in Arizona, and on beets and chard in other sections. It is not usually a serious pest of other leafy vegetables.

The bean aphid passes the winter in the North as eggs on species of euonymus, and to a limited extent on snowball and deutzia.

⁵ *Hyadaphis pseudobrassicae*.

⁶ *Aphis fabae*.

Little is known of its life history in the South, but probably successive generations of females are produced there throughout the year. A common weed, dock, is a favored host.

Macrosiphum ambrosiae is the scientific name of a large reddish aphid that damages lettuce in eastern Virginia, coastal South Carolina, and southern Texas. In eastern Virginia it feeds on endive plants.

An aphid known as *Macrosiphum barri* damages lettuce in Arizona, California, and some of the other western States.

The potato aphid ⁷ which occurs in both green and pink colors, attacks spinach at times in the fall in Virginia.

NATURAL CONTROLS

Sometimes natural controls hold down the aphid population. Other insects that kill aphids are

⁷ *Macrosiphum euphorbiae*.



Macrosiphum ambrosiae, an aphid that attacks lettuce and endive plants.

important natural controls. Fungus diseases and certain weather conditions also help destroy aphids.

Insects That Kill Aphids

Both parasitic and predatory insects help keep aphids in check.

Four-winged, wasplike insects parasitize aphids. The females lay eggs in the bodies of aphids; when the eggs hatch, the larvae feed on the aphids.

The parasites reproduce rapidly under favorable conditions. Usually they become abundant during spring and early summer.

The predatory insects that feed on aphids are lady beetles, soldier bugs, assassin bugs, and the larvae of lady beetles, syrphid flies, and green lacewings. They are most active during summer and fall.

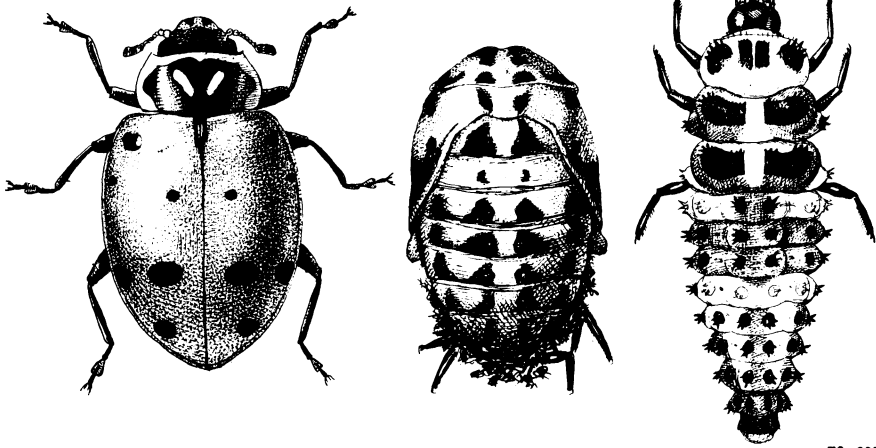
If inspection shows that insect enemies are present, do not apply an insecticide unless the aphids begin to increase. Insecticides also kill the insects that kill aphids. Then, aphids that survive multiply rapidly, and repeated applications of insecticide become necessary.

Diseases

Fungus disease sometimes kill aphids. However, this seldom happens before the aphids have become numerous and caused considerable damage.

Aphids killed by a fungus change shape and turn tan or light brown. Sometimes the fungus attaches them to the plant.

TC-7348



TC-2202

Adult, pupa, and larva of lady beetle—a beneficial insect.

Weather

Aphids are sensitive to weather conditions. Hard, driving rains kill large numbers of some species. Damp weather favors the development of diseases that kill aphids.

Aphids reproduce most rapidly at moderate temperatures. High temperatures are unfavorable to the kinds of aphids that attack leafy vegetables.

CONTROL MEASURES

You can control aphids by following cultural practices that keep the insects in check, and by applying insecticide.

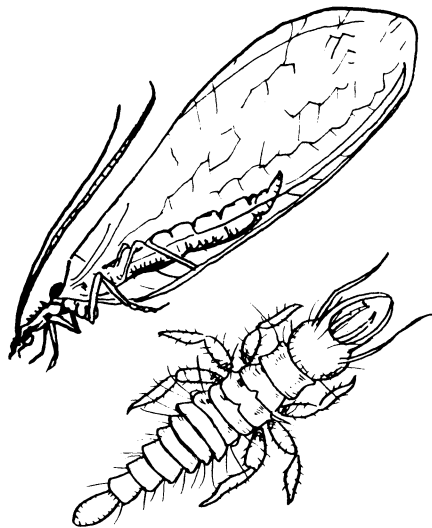
Cultural Practices

These cultural practices insure better crops, and help keep aphids under control:

- Start with a well-prepared, fertile seedbed.

- Do not plant on land from which a similar aphid-infested crop has been recently removed.

- Do not plant near a growing crop of aphid-infested vegetables.



BN-10060

Adult and larva of green lacewing.



BN-27052

Adult and larva of lady beetle, feeding on aphids. (Courtesy of Clemson Agricultural College, South Carolina.)

- Clear the field and surrounding area of aphid host plants.

- Plant seed in drills, to facilitate cultivation and application of insecticide.

- Apply a nitrogenous fertilizer (20 to 30 pounds of nitrogen per acre) soon after plants come up. Fertilize plants adequately throughout their growth.

- Irrigate during dry weather, if possible.

- Harvest the crop as soon as it is ready. Dispose of crop residue immediately.

Control With Insecticides

You should apply an insecticide as soon as it becomes evident that natural controls are not keeping the aphids in check. If experience

has shown that infestations are seldom checked by their insect enemies, start applications before the aphids become abundant.

SELECTING INSECTICIDES

In selecting an insecticide, choose a material that (1) is approved for use on your particular crop, (2) can be applied at the time needed without leaving excessive residue on the crop, and (3) can safely be applied with available equipment.

The accompanying table gives suitable insecticides for each crop, and tells how they can be applied and the time that should be allowed between the last application and harvest.

Following are general comments on the effectiveness of the insecticides recommended for use

against aphids and additional instructions for their use.

Demeton is usually effective in cleaning up early infestations. It can be sprayed on the plants or added to the transplant water. It is absorbed into the plants and protects them from migrating aphids for several weeks.

Diazinon is as effective as parathion or malathion against most aphids. It also kills other harmful insects including the imported cabbageworm and the larva of the diamondback moth.

Dimethoate is effective against most of the aphids. It is absorbed into the plants and gives relatively long-lasting protection.

Disulfoton is absorbed from the soil through the roots of plants and deposited in the foliage. This makes the foliage toxic to aphids for a considerable period of time. Because it works from within the plant, disulfoton is probably less injurious to natural enemies of the aphids than the other insecticides.

Apply disulfoton granules to the soil where the early developing roots will quickly contact it. In plant beds, broadcast the insecticide and mix into the top 2 or 3 inches of soil. In field rows apply only to the center portion of the rows before planting.

Endosulfan is recommended only for lettuce. It has very good fumigant activity and for best results should be used during periods of calm weather. On leaf lettuce do not apply endosulfan more than 2 times. On head lettuce do not apply endosulfan

more than 3 times after thinning; remove outside leaves at harvest. Do not feed crop waste to livestock.

Malathion can be used on almost all of the leafy vegetables. It is considered the safest of the insecticides listed. However, it is not as effective as the other insecticides and cannot be depended on to control the cabbage aphid. Its use will intensify smog damage to table beets, spinach, and certain types of leaf lettuce.

Methamidophos is very effective against aphids, but it is registered for use only on cabbage, cauliflower, broccoli, and brussels sprouts.

Mevinphos is especially useful in controlling aphids, caterpillars, and some other insects on most kinds of leafy vegetables where an application is needed shortly before harvest. It is as effective as parathion—even more so in some cases, because it usually gives better control of aphids that are hard to reach on the plants.

Naled is also useful in controlling aphids as well as other harmful insects shortly before the crop is to be harvested. It kills primarily by contact, therefore good coverage is necessary for best results.

Parathion can be used against aphids on commercial plantings of most leafy vegetables. It is also at least moderately effective against most of the caterpillars and other insect pests of leafy vegetables. Therefore, it is especially useful when other insects are present with aphids.

Insecticides, dosages, and formulations for control of aphids on leafy commercially produced vegetables

Insecticide	Crops on which it may be used	Minimum days from last appli- cation to harvest	Pounds per acre of active ingredients	Formulation ¹	Safety restrictions
Demeton (Systox).....	Broccoli, brussels sprouts, cabbage, cauliflower.	21	0.5	EC	(2)
	Lettuce.....	21	.25-.5	EC	
	Celery.....	28	.25-.5	EC	
Diazinon.....	Broccoli, cauliflower.....	5	.25-.5	EC, WP	(3)
	Cabbage.....	7	.25-.5	EC, WP	
	Brussels sprouts.....	7	.5	EC, WP	
	Celery.....	10	.5	EC, WP	
	Spinach, turnips, turnip tops.....	10	.25-.5	EC, WP	
	Swiss chard.....	12	.25-.5	EC, WP	
	Beets.....	14	.25-.5	EC, WP	
Dimethoate (Cygon, Rogor, De-fend)	Cabbage.....	3	.25-.5	EC	(3)
	Broccoli, cauliflower.....	7	.25-.5	EC	
	Lettuce, head.....	7	.25	EC	
	Collards, leaflettuce, mustard greens, spinach, swiss chard, turnip greens and roots.	14	.25	EC	

Disulfoton (Di-syston)--- Broccoli, brussels sprouts, cabbage, cauliflower.	(4)	(2)		
		1. 0	G, LC	
Lettuce-----	(4)	s 1. 0 -2. 0	G, LC	
Endosulfan (Thiodan, Malix).	14	0. 75-1. 0	EC, D, WP	(2)
Malathion-----				
Broccoli-----	3	. 62-1. 25	EL	
Turnips-----	3	. 5	WP (25%)	
Cabbage-----	3	1. 20	D (4%)	
Beets-----	7	. 93-1. 25	EL	
Brussels sprouts-----	7	. 93-1. 25	EL	
	7	. 5	WP (25%)	
	7	1. 20	D (4%)	
Cauliflower-----	7	2. 0	D (4%)	
Celery-----	7	. 93	EL	(3)
Collards-----	7	. 93-1. 25	EL	
	7	. 5	WP (25%)	
	7	1. 20-1. 40	D (4%)	
Lettuce-----	(6)	1. 25	EL	
		1. 25	WP (25%)	
		1. 20	D (4%)	
Mustard greens-----	7	. 62-1. 25	EL	
		. 5	WP (25%)	
		1. 20	D (4%)	

See footnotes at end of table.

Insecticides, dosages, and formulations for control of aphids on leafy commercially produced vegetables—Continued

Insecticide	Crops on which it may be used	Minimum days from last appli- cation to harvest	Pounds per acre of active ingredients	Formulation ¹	Safety restrictions
Malathion—Continued...	Kale.....	7	0.62 -1.25 .5 1.20	EL WP (25%) D (4%)	(3)
	Spinach.....	7	1.25 1.20 -1.40	EL D (4%)	
	Swiss chard.....	7	.93 -1.25 .5 1.20 -1.40	EL WP (25%) D (4%)	
Methamidophos (Monitor)	Cauliflower.....	28	.75 -1.0	EC	(3)
	Brussels sprouts.....	14	.75 -1.0	EC	
	Cabbage.....	35	.75 -1.0	EC	
	Broccoli.....	14	.5	EC	
	Broccoli.....	21	.5 -1.0	EC	
Mevinphos (Phosdrin)---	Broccoli, cabbage.....	1	.125- .25	EC, SP, D	(3)
	Lettuce.....	2	.125- .25	EC, SP	

Mevinphos (Phosdrin)— Continued		3	7. 125- .25	EC, SP, D	(3)
Spinach-----		4	. 125- .25	EC, SP, D	
Naled (Dibrom)-----		1	1.0 1.2 -2.0	EC D	(3)
Broccoli, brussels sprouts, cabbage, cauliflower.					
Collards-----		4	1.0 1.2 -2.0	EC D	
Lettuce, spinach, swiss chard, tur- nip greens.		1	1.0 -1.5 1.2 -2.0	EC D	
Parathion ethyl-----		7	7. 18 - .5 7. 15 - .5 7. 2 - .5	EC WP D	(3)
Cabbage, collards, turnips-----		10	. 18 - .5 . 15 - .5 . 2 - .5	EC WP D	
Kale, mustard greens-----		10	. 15 - .5 . 2 - .5	EC, WP D	
Spinach-----		14	. 2 - .5	EC, WP, D	

See footnotes at end of table.

Insecticides, dosages, and formulations for control of aphids on leafy commercially produced vegetables—Continued

Insecticide	Crops on which it may be used	Minimum days from last appli- cation to harvest	Pounds per acre of active ingredients	Formulation ¹	Safety restrictions	
Parathion ethyl—Cont....						
	Lettuce, bib and leaf.....	21	0.25 - 0.5	EC	(3)	
			.45 - .5	WP		
			.35 - .5	D		
	Lettuce, bib and leaf.....	14	.25	EC, WP, D		
	Lettuce, head.....	7	.5	EC, WP, D		
<hr/>						
Beet:						
Roots.....	15	.15 - .5	EC, WP			
		.2 - .5	D			
Tops.....	21	.15 - .5	EC, WP			
		.2 - .5	D			
<hr/>						
Celery.....	21	.2 - .5	EC, WP			
		.4 - .5	D			
Swiss chard.....	21	.5	EC			
		.2 - .3	D			

¹ D=Dust, EC=Emulsifiable concentrate, EL=Mulsifiable liquid, G=Granular, LC=Liquid concentrate, SP=Soluble powder, WP=Wettable powder.

² This product is toxic to bees and should not be applied when bees are actively visiting the area.

³ This product is highly toxic to bees exposed to direct treatment or residues on crops.

⁴ At planting.

⁵ 20-in row spacing.

⁶ 14 leaf or 7 head.

⁷ Refer to label for higher rate requirements.

Parathion kills many insect enemies of aphids. As a result, aphids multiply rapidly, and frequent applications may be necessary.

Parathion is not effective at low temperatures. If maximum daily temperatures below 70° F. persist after application, do not harvest for 17 days after treatment.

Applying Insecticides to the Foliage

Apply insecticides to the foliage of plants by either spraying or dusting.

Spray or dust during calm, warm weather. Cover plants thoroughly; be sure the insecticide reaches aphids on the undersides of leaves, and inside folded leaves and buds.

Spraying.—Spray with demeton, diazinon, dimethoate, endosulfan, malathion, methamidophos, mevinphos, naled, or parathion. Each of these is available

as an emulsifiable concentrate or wettable powder. Mix with water as directed in the table.

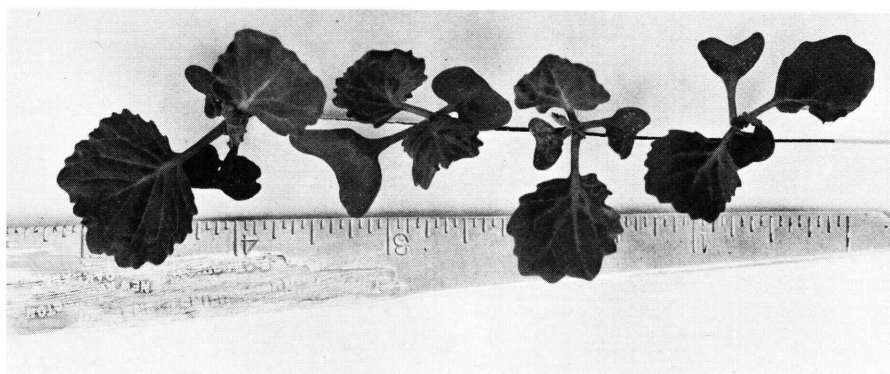
Use 20 to 100 gallons of mixed spray per acre. Maximum amounts of insecticide are needed when plants are large or the infestation is heavy.

Sprays should be used as soon as possible after they are mixed.

Dusting.—Dust with malathion, mevinphos, parathion, endosulfan, or naled. The dusts are ready to use when purchased.

Apply dusts when plants are moist but not wet, and when there is little wind. These conditions exist most often after sunset and early in the morning. Effective dusting can be done at night, with the aid of hand-held lights or lights mounted on the equipment. Early morning dusting is satisfactory unless the plants are so heavy with dew that the dust runs off the leaves.

If wind is a problem, cover nozzles of the duster with a cloth



TC-7058

Insecticides are often needed to protect young plants against aphids, especially the turnip aphid, soon after the first true (crinkled) leaves appear. Plants shown above are at that stage of growth.



TC-7316, TC-7315

Tractor-mounted dust machine suitable for applying an insecticide dust for control of aphids: A, With cloth hood over outlet nozzles to reduce drift of dust (addition of a cloth plastic apron that trails 15 to 25 feet behind the hood is usually of further value); B, Same machine without cloth hood.

or plastic apron. Allow apron to trail 15 to 25 feet behind the duster.

Use 20 to 25 pounds of dust per acre.

When to apply.—The best time to apply insecticides to foliage varies in different localities. For information about your area, consult your county agricultural agent, State extension entomologist, or State agricultural college.

Generally, you should start looking for aphid infestation in the early stages of plant growth. Examine plants in various parts of the field. If you find only a few aphids, examine plants every few days. If aphids begin to increase rapidly, apply an insecticide before they become abundant.

Time the applications so crops will be free of aphids when ready for harvest. Presence of aphids on a marketed crop, such as spinach, greatly reduces the crop's value.

Do not apply an insecticide too close to harvesttime. If you do, too much residue may remain on edible parts of the crop. Crops having excessive residues may not be shipped across State lines. The table lists, for each crop and each insecticide, the minimum days that should elapse between application and harvest.

USE OF PESTICIDES

This publication is intended for nationwide distribution. Pesticides are registered by the Environmental Protection Agency (EPA) for countrywide use un-

USING INSECTICIDE IN TRANSPLANT WATER

Spray or dust plants with insecticide before pulling them for transplanting.

Add an insecticide labeled for use in transplant water. The chemical is absorbed by young plants, and protects them while they are becoming established in field rows. Use at least 450 gallons of water per acre or at least $\frac{1}{2}$ cupful for each plant. This volume will be required when about 14,500 plants are transplanted per acre, if they are set 1 foot apart in 3-foot rows.

less otherwise indicated on the label.

The use of pesticides is governed by the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended. This act is administered by EPA. According to the provisions of the act, "It shall be unlawful for any person to use any registered pesticide in a manner inconsistent with its labeling." (Section 12(a) (2) (G))

EPA has interpreted this Section of the Act to require that the intended use of the pesticide must be on the label of the pesticide being used or covered by a Pesticide Enforcement Policy Statement (PEPS) issued by EPA.

The optimum use of pesticides, both as to rate and frequency, may vary in different sections of the country. Users of this publication may also wish to consult their

Cooperative Extension Service, State Agricultural Experiment Stations, or County Extension Agents for information applicable to their localities.

The pesticides mentioned in this publication are available in several different formulations that contain varying amounts of active ingredient. Because of this difference, the rates given in this publication refer to the amount of active ingredient, unless otherwise indicated. Users are reminded to convert the rate in the publication to the strength of the pesticide actually being used. For example, 1 pound of active ingredient equals 2 pounds of a 50 percent formulation.

The user is cautioned to read and follow all directions and precautions given on the label of the pesticide formulation being used.

Federal and State regulations require registration numbers. Use only pesticides that carry one of these registration numbers.

USDA publications that contain suggestions for the use of pesticides are normally revised at 2-year intervals. If your copy is more than 2 years old, contact your Cooperative Extension Service to determine the latest pesticide recommendations.

The pesticides mentioned in this publication were federally registered for the use indicated as of the issue of this publication. The user is cautioned to determine the directions on the label or labeling prior to use of the pesticide.

SPECIAL PRECAUTIONS

Malathion can be used safely without special protective clothing or devices if it is in diluted dust or water-spray form. However, malathion concentrates require special precautions.

Diazinon, dimethoate, endosulfan, and naled can be absorbed directly through the skin in harmful quantities. When working with these insecticides in any form, use extra care.

Demeton, disulfoton, mevinphos, methamidophos, and parathion are extremely poisonous and may be fatal if swallowed, inhaled, or absorbed through the skin. They should be applied only by a person who is thoroughly familiar with their hazards and who will assume full responsibility for safe use and comply with all precautions on the labels. Reduce the danger of skin exposure to these insecticides by wearing recommended protective clothing and equipment. Wear a respirator or mask of a type that has been tested and found to be satisfactory for protection against the particular insecticides you are using.

Wear clean, dry, cotton gloves if you transplant or handle plants within 5 days after treatment with demeton, disulfoton, parathion, or methamidophos, or within 1 day after treatment with mevinphos.

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